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DIABETES MELLITUS.

AN

ADDRESS

READ BEFORE THE

Rhode Island Medical Society,

AT THEIR ANNUAL MEETING,

PROVIDENCE, R. I.,

JUNE 7, 1854.

BY S. CLAPP, M. D.

PAWTUCKET:
R. SHERMAN, PRINTER.
1854.

Sylvanus Clapp, M. D:

Dear Sir:—The undersigned, in behalf of the Fellows of the Rhode Island Medical Society, tender you their hearty thanks for your very able and interesting discourse upon Diabetes Mellitus, read before the Society at their Annual Meeting; and request a copy of the same to be placed in the hands of the Secretary for publication.

Very respectfully,

June 8, 1854.

J. H. ELDRIDGE, ARIEL BALLOU, } Committee.

NORTH PROVIDENCE, R. I., June 12, 1854.

Drs. Eldridge and Ballou:

Gentlemen,—I received your note of the 8th, tendering me the thanks of the Rhode Island Medical Society for my Address, read June 7th, 1854, and requesting a copy of the same to be placed in the hands of the Secretary for publication. I hasten to comply with your request, and feel myself much honored by this mark of their approbation.

With the highest respect,

I remain yours, &c.

S. CLAPP.

To JAS. H. ELDRIDGE, ARIEL BALLOU, } Committee.

ADDRESS.

MR. PRESIDENT AND GENTLEMEN
OF THE RHODE ISLAND MEDICAL SOCIETY:

A summary of what is now known of the disease called *Diabetes Mellitus* I have thought might be interesting to the Fellows of this Society. In addressing you on this subject, it must not be presumed I could give you a full statement of all the views entertained by different writers, or speak fully of all its relations, physiological and pathological, for it would furnish us with sufficient material for an extended treatise.

Much has been written on this subject within a few years, and is, for the most part, scattered over the pages of our numerous medical journals. In the present day, when literature in every shape has compassed the land; when a new discovery in medicine is heralded by those iron intellects, those iron nerves, that convey our thoughts from one end of creation to the other; when knowledge may be truly said to "run to and fro" throughout the earth; it might be thought unnecessary to follow the old school system of detailing the early history of this disease, were it not that the views entertained by some of the earlier writers, not only become interesting, but instructive.

It would afford us, however, neither literary interest or practical utility commensurate with the task, to detail minutely all the opinions entertained among the earlier writers. Some of the most important among the Greeks and Romans will be alluded to.

In commencing the history of this disease, we are led back to the names and labors of the mighty dead; and commencing with the views of Celsus among the Romans, and Galen, Aretus and Alexander Trallianus among the Greeks, the first writers who gave a clear and minute history of the disease, I hope to pursue the subject with interest; giving you a hasty sketch of the different views entertained of the disease, from a remote period down to the views now entertained by some of our *illustrious living* disciples of Medicine.

Celsus looked upon the disease as one of renal irritation; Aretus gave the most minute and clear description of it, of any of the ancient writers. He considered it a sort of colliquative diarrhea, which melted the flesh and limbs into urine. He says "this colliquation of the flesh and limbs passes off by the kidneys and bladder; for the patients never cease voiding their urine, but as from the opening of water ducts, the stream is perpetual." Galen looked upon the disease as one of renal irritation, and bearing the same relation to the kidneys and bladder, as diarrhea to the stomach and intestines.

Alexander Trallianus possessed similar views with Galen and Aretus. Hippocrates was ignorant of this disease, for he makes no allusion to it in any of his writings.

The views of Galen and Aretus were entertained with very little alteration until the time of Thomas Willis, who lived in the time of Charles II. of England; and according to all writers, was the first of all men from the beginning of time, who tasted the urine of a diabetic patient. To him, then, should be awarded the praise of first discovering the saccharine property of the urine. He says "the subjects of this disease pass more urine than the whole quantity of fluids taken into the body; they have, besides, a constant thirst, and a slow kind of hectic fever always on them. It is very far from true, as some authors affirm, of the drink being again discharged with little or no alteration; for the urine

in all that I have seen (and I believe it will universally be the case) is different not only from their drink, and from every other fluid in the animal body, but was like as if it had been mixed with honey, or with sugar, and had a wonderfully sweet taste."

He acknowledges the fatality of the disease, although he thinks it curable at first, and enumerates several remedies. He thought the blood was so much dissolved, as to have its parts considerably separated, so that it could not be again restored.

Sydenham, who was cotemporary with Willis, gave a very clear and minute description of the disease, and, adopting the same views concerning the nature of the malady, says:

" Diabetes is rather an immediate affection of the blood than of the kidneys, and thence derives its origin; for the mass of the blood becomes, so to speak, melted down, and is too copiously dissolved into a state of serosity, which is sufficiently manifest from the prodigious increase of the quantity of urine, which cannot arise from any other cause, than from this solution and waste of blood.

This opinion being promulgated and maintained by two of the brightest luminaries of the healing art, was extensively adopted, and continued to be the prevailing opinion until Dr. Rollo's work appeared. Dr. Rollo attributed the disease to a morbid condition of the stomach. He says " it consists in an increased action and secretion, with a vitiation of the gastric fluid, and probably too active a state of the lacteal absorbents; while the kidneys and other parts of the system, as the head and skin, are only affected secondarily."

Notwithstanding the able and excellent article of Dr. Rollo, Dr. Latham afterwards adopted the opinion of Drs. Willis and Sydenham. These two theories continued to receive the successive support of many of the ablest and most distinguished pathologists for many years. In the year 1778, Mr. Charles Darwin, an ingenious physiologist, presented a bold paper before

the Æsculapian Society of Edinburgh, endeavoring to account for the disease by a retrograde motion of the lymphatics. He considered that all the branches of the lymphatics sympathized with each other; and that the greater part of the chyle passed off by the kidneys, without entering the general circulation. He also proposed a new name for the disease,—" *Chyliferous Diabetes.*"

The more distinguished physiologists, however, of his day, never became converts to his hypothesis. They adopted the same notions concerning this hypothesis with Mr. Criuckshank, that it was a mere supposition depending upon no experiments.

Prof. Frank, in the year 1782, without abandoning the hypothesis of Darwin, endeavored to modify it so as to make it appear less objectionable. He gives up the doctrine of retrograde motion, but conjectures that it is dependent upon excitement of the lymphatic system generally; and that the urinary combines with this general excitement, and that it is dependent upon some specific *virus*, which excites an inextinguishable desire for liquids, and alludes, in illustration, to the virus of the Dipsas, a serpent of the ancients, which was proverbial for producing this effect. He supposed that from this irritability of the lymphatics, every other part of the system suffers in consequence, and that the chyle is hurried forward, together with the cutaneous exhalation, to the kidneys which concurs in the same diseased action, and constitutes the flow of saccharine urine. His opinions were received with no more favor than Darwin's. He did not attempt to explain why the urinary secernents, in this general excitement, should be so much more successful than those of other organs, the skin or intestines.

Another hypothesis placed the disease primarily and idiopathically in the kidneys. The kidneys were the organs first suspected, and the Greek writers supposed them to be in a state of relaxation and irritability. To this state was ascribed their morbid activity;

while their weakened and relaxed condition allowed the serum of the blood to pass off through the patulous mouths of the excretories, in a crude and inelaborate form, as the food does in lientery.

This, although the first opinion, and advanced by Galen, has, perhaps, until recently, been the hypothesis most generally admitted. Bonet, Reysch, Cruickshank and Dr. Mason Good, embraced these views.

Dr. Marsh ascribed the cause to a morbid condition of the skin and interruption of its functions.

Dr. Mead thought it depended on a morbid state of the liver and bile.

Dr. Bailie, to a deranged action of the secretory structure of the kidneys by which the blood there is disposed to new combinations. He, at the same time, supposed the chyle was imperfectly formed, and caused the blood to be more readily changed to saccharine urine by the kidneys.

Dr. Lubbock, considering the coincidence of the dry skin in connection with Diabetes, formed his theory of the disease. He says "it has been proved that sugar is, for the most part, composed of carbon, oxygen and hydrogen, united in a certain ratio, and it appears, by the experiments of Cruickshank and Abernethy, that besides the occasional aqueous fluid discharged daily from the surface of the body, about three gallons of carbonic acid are also lost to the system by the perspirable matter. Now supposing, as happens in Diabetes, this perspirable excretion or carbonic acid, is suppressed and retained in the system; it is probable that the carbon and oxygen of the acid, so retained, by entering into a due combination with some portion of the hydrogen of the animal body, may tend to the production of the saccharine urine; and as the carbonic acid is the general product of the vegetable world, it would follow that its retention in the animal body may produce the phenomena of the defective

assimilization, characterizing Diabetes in the formation of sugar."

These embrace nearly all the hypotheses concerning the nature of this disease entertained by most writers, until the essay on Diabetes by McGregor, and an experimental essay on the physiology of the blood by Dr. Maitland of St. George's Hospital. From the time the theory of diseased irritability of the kidneys was promulgated until these essays, the efforts of the physician were for the most part directed to the kidneys.

That many of the hypotheses of the earlier writers bear marks of the crude and imperfect notions entertained of the pathology of the disease, is not at all to be wondered at; neither is it a matter of surprise that these notions should have so long been adhered to, when we consider the *reverence* paid in those days to the opinions of the *fathers of Medicine.* But the steady advancement of medical science has thrown new light upon this, as well as many other diseases. Many of these theories furnish us with nought more than shifting sands, for our knowledge of this disease. All *true* knowledge is more or less difficult to attain, and particularly so in medicine; yet it has advanced slowly and surely. All the natural sciences have been obliged to pass through a slow and irregular moving process. Ages may elapse after facts are established and recorded, before their relations are well understood, and they become serviceable to mankind. Little by little do facts sometimes accumulate, and become a part of one great whole; the wheat and chaff, the gems and rubbish, are all garnered together into one heterogeneous mass, until some *master mind* appears and makes the uncertain, certain, and the indefinite, definite. It is in the character of Claude Bernard we find such a *master spirit.* His name stands among the foremost of living physiologists. We shall have occasion shortly to speak of this dintinguished Frenchman, and to notice at considerable length his brilliant physiological researches.

From the essays of McGregor and Maitland, we glean the following:

That the stomach, in Diabetes, has the property of forming sugar from animal as well as from vegetable food;

That sugar is contained in the blood, urine, saliva and feces;

That more urea is passed than in health.

No urea has been found in their blood, though albumen has been found in their urine. (*Bouillaud clinique, Med. III.*, 289. *See Braithwaite.*)

FOUND

In the blood in Diabetes Mellitus.	*In urine.*
Excess of sugar.	Excess of sugar.
Excess of water.	Excess of water.
Urea unknown.	Excess of urea.

Analysis of the blood in Diabetic patients has been often made, by various individuals, and with very different results. While some detected large quantities of sugar, others were unable to detect any. It was natural enough to suppose the blood became deranged by this morbid drain. We might at first suspect *inspissation* of the blood to occur in Diabetes, when the flux of water is so great; but when we remember the high specific gravity of the urine in this disease, and the great quantity of solid matter running to waste, we are prepared to believe the contrary. The solids of the blood are relatively diminished, and despite the immense elimination of water, the specific gravity of the blood is below its standard. In fact, the only disease, I believe, in which the excretions gain on the fluidity of the blood, so as to inspissate it, is cholera.

The analysis of blood in Diabetes has been made by Nicolas and Guendeville, Wallaston, Marcet, Henry, Prout, Ambrosiani, Maitland and others.

The analysis of Ambrosiani and Maitland, since those of Prout, &c., have proved the existence of sugar in the blood of Diabetic

patients, the specific gravity of the serum of which may rise to 1060 from its presence, and McGregor has also established the fact of its unusual production during the process of *digestion.*

Bouchardat has satisfactorily ascertained the fact, that the sugar in the blood of Diabetic patients is at its maximum during the process of chylification, and that it almost disappears after a long fast.

The contradictory results obtained by physiologists with regard to the presence of sugar in the blood is due chiefly, according to M. Bouchardat, to the following circumstance.

If you examine Diabetic urine at different periods of the day, you will find that an hour or two after meals it is abundantly secreted, and contains a considerable proportion of sugar, which successively decreases for the next twelve or fifteen hours; beyond this term, if the patient has eaten nothing, no trace of sugar will be found in the blood. By two comparative analyses, M. Bouchardat sustains his position. In a patient bled at 9 o'clock, A. M., who had fasted since 5 o'clock the previous evening, no trace of sugar was detected. In another patient, bled two hours after a light breakfast, there was unequivocal evidence of sugar in the blood. These observations of M. Bouchardat have been confirmed by Simon,* one of the ablest writers in pathology of the present day.

The urine not only increases in *quantity* in this disease, but in *density.* Instead of being within 1010—1020, which are probably the limits in health, the specific gravity usually ranges between 1035—1045, and in some instances, as stated by Maitland, as high as 1060. The discharge of solid matter from the blood must, therefore, be very great. Dr. Christison has calculated that 2 1-2 ounces of solid matter are discharged daily from the blood of a person in a state of health, of which nearly one half is urea. Calculating from the table of Dr. Henry,

*William's Principles Medicine.

inserted in Dr. Prout's work, a case related by Dr. George Budd and treated by him in the hospital, acting under the advice of Dr. Bouchardat, (the case of Joseph Hawkesworth,) 20 ounces of solid matter were daily discharged from the blood, of which a great proportion was sugar. (*Braithwaite's Retrospect, No.* 5, *page* 71.)

Dr. Bouchardat's theory is, that the disease arises originally from suppressed perspiration: in other words, "from the acid secretion of the skin being suddenly and completely interrupted, in consequence of which the secretions of the mucous membrane and of the glands of the digestive organs are altered in their chemical composition, and become almost completely acid instead of being alkaline." His theory has been objected to by men equally eminent as himself, as being too chemical.

Dr. Prout, who, for many years, was justly regarded as high authority, and whose opinions are still regarded as excellent, considers Diabetes to arise from a loss of power in assimilating the saccharine principles we take as food—sugar and articles used as aliments derived from the vegetable kingdom. He was for a long time in the habit of directing his attention closely to diseases of the urinary organs, and considers it of much more frequent occurrence than many other writers. It is probably much more frequent in Great Britain and in Germany, than in our own country. I am unable to quote from the several editions of his valuable work, (having but one,) therefore quote from Braithwaite's, from an article by H. Bence Jones. In the edition of 1821, Dr. Prout gives no cases of his own; in 1825, twenty cases. The average of four years was five cases a year. In 1840, no statement is made. In 1843, five hundred cases. The average of eighteen years was twenty-seven cases a year. In 1848, seven hundred cases. The average of five years was forty cases a year.

It is not a frequent disease in the New England States. In the State of Massachusetts, which, as appears from the eleventh registration report, submitted to the Legislature by my esteemed friend Ephraim Munroe Wright, Secretary of State, who, considering the great importance of the abstracts, caused it to be prepared under the immediate superintendence of Nathaniel B. Shurtleff, M. D., of Boston, we find the following statement. It is probably the most correct document of the kind that has ever appeared in the United States.

The population of Massachusetts, by the last census, was 830,066 native inhabitants, 160,909 of foreign birth, and 3539 unknown; making, in all, an aggregate of 994,514; standing as the sixth in extent of population, and exceeded only by New York, Pennsylvania, Ohio, Virginia and Tennessee. As to density of population, it stands the first among the States of the Union, containing 127,49 inhabitants to a square mile of territory. With the exception of Rhode Island, New York and New Jersey, the density is more than 100 per cent. greater than any other State.

Out of this population, 18,482 deaths occurred in the year 1852. *Twenty-two* only of these were from Diabetes. They occurred as follows: 4 males in Jan.; 2 males and 1 female in Feb.; 1 f. in March; 1 m. and 1 f. in April; 2 m. and 2 f. in May; 1 m. in June; none in July; 1 m. in Aug.; 1 m. and 1 f. in Sept.; none in Oct.; 2 m. and 1 f. in Nov.; 1 m. in Dec.

There occurred between the ages of 5 and 10 years 1 f.; 10 and 15, 1 f.; 20 and 30, 6 m. and 2 f.; 30 and 40, 3 m. and 2 f.; 40 and 50, 3 m. and 1 f.; 50 and 60, 1 m.; 70 and 80, 2 m.; none over 80, none between 60 and 70, and none between 15 and 20 years of age. Fifteen of these were males and 7 females.

The month of January and May were the most fatal,—4 m. in Jan., and 2 m. and 2 f. in May.

Between the ages of 20 and 30, 8 died; being the greatest number at this age.

Thus we have only 22 dying of Diabetes out of 18,482 deaths occurring in a population of 994,514.

From a table of the deaths occurring in Boston for the year 1853, as published in the Boston Medical and Surgical Journal, but *one* death is reported from Diabetes out of 4276 deaths.

We see by these statistics that it may occur in early life, but that it is most frequent when the body is in full vigor, which coincides with the views advanced by Dr. Watt. Heberdeen supposed it attacked the aged and infirm exclusively.

It not unfrequently comes on slowly and insidiously, until the large quantity of urine voided is first noticed by the patient, together with the thirst, which at times is inordinate. These symptoms go on increasing until the quantity voided is sometimes very great, and the thirst becomes insatiable, particularly during the night. The urine has a straw color, and smells like the second crop of new mown hay. The amount has been known to exceed seventy pounds in some rare instances, in the course of twenty-four hours. Dr. J. L. Bardsley, in his hospital facts and observations, relates two cases, one of thirty-six pints, and one of thirty-two pints. The discharge, generally speaking, is less than the quantity of liquid drank, yet well authenticated cases have occurred where the quantity voided was much greater than the quantity of solid and liquid ingesta. This fact has been denied by some writers. But patients have been daily weighed, together with the quantity of ingesta, both solid and liquid, when the egesta exceeded that of the ingesta, and yet the patient had actually gained in weight. Dr. Bardsley, in his excellent article in the Library of Practical Medicine, asks: "To what law or process of the animal economy is this supply of the superabundant quantity of urine to be attributed? Is it derived from cuticular or pulmonary absorption?" The re-

searches of Klapp and Dangerfield, two British physiologists, render it highly probable that this superabundant quantity is absorbed by the lungs from the moisture of the atmosphere. "Numerous observations" by those two individuals "demonstrate that almost every kind of matter in the state of fluid or vapor introduced into the air cells of the lungs, is rapidly absorbed from thence into the circulation, and, generally speaking, presents itself at the kidneys." (*Lib. Prac. Med.*)

Schonlein states that in the early stage of Diabetes, there is no sugar in the urine, but albumen; and as this disappears, the formation of sugar begins. (*Simon's Chem. Syd. Ed.* 11., 290.)

We consider the excretion of sugar by the kidneys essential to constitute the disease. It has been considered that Diabetic urine is always sweet. But the urine of the same patient, at different times, may contain tasteless and sweet sugar. Dupuytren, Thernard, Bouchardat and Simon relate cases proving this. Dr. Bouchardat, in the Revue Medicale, June, 1849, writes thus: "At the commencement of my researches, I thought that Diabetic urine contained very rarely this variety of tasteless sugar; but nothing is more common. Most patients, with sweet Diabetes, who live on animal and vegetable diet, pass urine which contains this tasteless sugar. It crystalizes exactly like grape sugar. It differs only in its taste, which is perfectly insipid, not only when crystalized, but when in solution; when fermented, it gives the same quantity of carbonic acid and alcohol as grape sugar. Alkalies have the same action on it, as on grape sugar; blackening it. Acids, when cold, have no effect on it, but when boiled for ten hours in water, acidulated with one tenth of sulphuric acid, this insipid is changed into sweet sugar, which can be crystalized. The insipid and the sweet sugar are two isomeric bodies. It is a curious fact that this intermediate body, (which resembles dextrine in its insipidity and property of becoming sweet when boiled with acids, and which differs from dextrine in

its crystalization and solubility in alcohol, and in immediately being capable of undergoing alcoholic fermentation,) is a substance we cannot prepare in the laboratory, and which hitherto has been only made under the influence of organization; in this resembling most closely milk sugar." (*Braithwaite.*)

Dr. Simon, page 454, says: "I once had an opportunity of seeing such sugar in the urine. A young woman with Diabetes, eight weeks before her death, was passing a large quantity of saccharine urine; specific gravity 1032. The sugar, when separated, had all the properties of grape sugar. She became much weaker, and two days before her death, the urine, specific gravity 1021, was again sent for examination, and I was not a little astonished to find a perfectly tasteless sugar, soluble in hot alcohol; there was mixed with it a considerable quantity of a substance more like gum, which was insoluble in alcohol, and when heated, had a peculiar smell."

Dr. H. Bence Jones reasons thus: "The greater portion of the starch we take passes into dextrine; all the dextrine becomes sugar, and all the sugar is converted into vegetable acid previous to its being oxydized into carbonic acid. The changes which occur in health may be represented by the following series: starch, dextrine, sugar, vegetable acid, carbonic acid."

The disease Diabetes, he considers "arises from the arrest or stoppage of these healthy and necessary changes. The series of changes is stopped at the sugar; from some cause, the conversion of the sugar into vegetable acid and carbonic acid does not take place; and the whole series of changes may be indicated by the terms starch, dextrine, sugar." (*Braithwaite, Part* 21.)

In *health*, then, we have these changes, starch, dextrine, sugar, vegetable acid, carbonic acid.

In *Diabetes*, starch, dextrine, sugar.

This insipid sugar was noticed as early as 1810 by Dupuytren and Thernard; since then, by Bouchardat and Simon.

Dr. H. Bence Jones says "this insipid sugar *resembles* sugar of milk in its insipidity. It *differs* from it in not giving rise to mucic acid, and undergoing fermentation. The conversion of the insipid sugar into grape sugar, by the effects of acids, indicates its place among the sugars, and makes it probable that starch, in its passage through the system, undergoes this change also; and thus the whole series at present known will be starch, dextrine, insipid sugar, sweet sugar, vegetable acid and carbonic acid." (*Braithwaite, page* 21.)

These cases are well named *Diabetes insipidus.* An *excess* of urine never should be called Diabetes insipidus, unless we are sure this tasteless sugar is present, and this can be pretty well ascertained by the quantity and specific gravity, which is usually sufficient to distinguish it from *diuresis.*

The formation of sugar in the process of digestion, and the absorption of this sugar into the blood, were therefore considered cardinal facts in the pathology of Diabetes; and to explain these, must be the prime object of all theories of this disease. Let us now see with what success this object has been attained. And this leads us to the interesting researches of Claude Bernard, before alluded to.

The name of Claude Bernard stands foremost among living physiologists. He has advanced the science of physiology more than any other man of our own times, by his difficult and important experiments on living animals; elucidating many important and difficult problems in the phenomena of life. He was a pupil of the celebrated Magendie, and, of course, derived from him much of his ready tact in operating successfully on living animals.

From the experiments of Dr. Beaumont on Alexis St. Martin, many years since, in our own country, other physiologists have

taken the hint, and performed similar experiments on the lower animals; and thus we have been made acquainted with the peculiar functions of most of the organs in the human body.

Comparative physiology, as taught and exhibited by M. Bernard, has led to some brilliant discoveries; but the most brilliant of all his physiological achievements is the discovery of the formation of *sugar by the liver.* It is not enough for us to mention this fact merely, but to speak of it in the highest terms; indeed, we cannot estimate too highly the zeal with which he pursued his researches, or the sagacity he displayed in interpreting their results. Pathological phenomena first drew his attention to the subject.

It appeared to him a remarkable circumstance that Diabetic patients, while restricted most absolutely to azotized food, should yet continue to pass large quantities of sugar with their urine. Before entering more definitely on the discovery of the formation of sugar by the liver, and another discovery by Bernard and Barreswell, (the hepatico-renal circulation,) I ought to consider for a moment some of his researches respecting the digestion and assimilation of food.

A very interesting review of nearly all the physiological discoveries of Claude Bernard has appeared in the For. Brit. Med. Chig. Review, from the pen of Harvey Ludlow. He has made so clear and succinct a statement of his labors, I have thought proper to quote largely from this article. Passing over that portion of it for the present which treats of his inquiries on the hepatico-renal circulation, and the secretion of sugar by the liver, I enter at once on his inquiries into the digestive system. "One of the most important consequences of these discoveries has been the establishment of the doctrine, that animals, like vegetables, are endowed with the power of transforming one ternary principle into another, and also of changing quaternary principles into ternary, by eliminating nitrogen from the former and con-

verting them into sugar and fat; in short, that the power of chemical *combination*, as well as of chemical *destruction*, has been conferred alike on animals and vegetables. Other observers have contributed in no small degree to the recognition of this *important truth.* But the inquiries instituted by Bernard with reference to the formation of sugar in the liver, has resulted in proving that such transformation is a *constant* and *habitual* process of the animal economy; and the evidences of its operation may be detected in almost all the vertebratae and in a large number of invertebrated animals." (*Braithwaite.*)

Saccharine matters, after being in part changed into lactic acid, together with it, are absorbed by the veins of the stomach, the fat, set free, is carried through the pyloric orifice of the stomach, with the other unchanged alimentary matters, into the duodenum. In the *small intestines*, the *bile* forms an emulsion with the fluid fat; this is absorbed by the lacteals.

The pancreatic secretion is supposed to act on the starch, and converts it into dextrine and glucose. The mesenteric veins absorb the lactic acid, dextrine and glucose, and other soluble matters.

In the large intestines, the same process of absorption goes on; the only chemical change being the formation of lactic acid from the cane and Diabetic sugar, which had passed unchanged from the upper part of the tube. The matters taken up by the veins of the stomach and intestines, being conveyed by the vena porta to the liver, the superfluous glucose, and other ingredients, are again returned to the intestines in the bile, to be again absorbed and conveyed to the liver, to go through the same changes; thus giving time for those transformations to be effected in the blood which are necessary to complete assimilation. When more substances, not prepared for entering into the blood, are carried to the liver than that organ is capable of throwing off, the kidneys take on a part of its action, and the glucose that

has got furtively into the circulation, is excreted with the urine. This leads us to speak of the hepatico-renal circulation discovered by Bernard; but before dismissing this part of our subject, we will notice for a moment a *striking* analogy, and a little *remarkable*, that exists between *plants* and *animals*. This analogy is from M. Mialhe, although Cuvier, in his report on the progress of science, as early as 1810, hinted at it.

In *plants*, starch can only minister to nutrition by being rendered soluble by ferment (diastase,) which is secreted, not in the radicles, nor in the shoots, but just where theory tells us it ought to be; close to the germ. In like manner, in *animals*, starch cannot be assimilated until it has been similarly acted on, and *diastase* is found in the *mouth* and in the *intestines*. Vegetables cannot appropriate to their supply the neutral hydro carbons until the alkali contained in the soil has transformed these substances into others which are soluble, and chiefly into ulmine. *Animals* also can only apply to the uses of the organism these same substances after they have been acted on by the alkalies of the vital fluid, and ulmine is one of the products of the reaction. Here we have a hint for the treatment of this disease first proposed by Mialhe.

In *vegetables*, the vital fluid, the sap, is always neutral or acid; in healthy *animals*, the blood is always alkaline. In healthy *vegetables*, the sap contains *glucose;* in healthy *animals*, the blood contains no *glucose.*

In some *diseased* animals, (Diabetic,) the blood is *acid*, and contains *glucose;* and in some *diseased plants*, the sap becomes alkaline, and contains no *glucose*. (*See Am. Jour. Sciences, Jan. No.*, 1847, *from an article by Dr. S. O. Curran.*)

We have now arrived in our investigation of this disease to the discocery of the *hepatico-renal circulation*. Dr. F. Donaldson of Maryland, in an article published in the American Journal

of Medical Sciences for July, 1851, was the first writer in this country who published anything in regard to this important discovery. He witnessed the experiments, and was convinced of their accuracy. They were performed by Bernard. He states that there exists a communication between the portal vein, the ascending cava, and the kidneys, by means of which the urine is secreted from blood which has not as yet passed through the general circulation. It is called the *hepatico-renal circulation* by its discoverer.

Although considered accurate, and the experiments justify us in arriving to such a conclusion, a series of anatomical researches is necessary to demonstrate the three following necessary conditions:

1st. A direct anastamosis between the vena porta and inferior cava;

2d. Muscularity of the ascending cava below the entrance of the hepatic blood;

3d. Valves below the orifice of the renal veins.

The absence of either of these anatomical conditions would render the hepatico-renal circulation impossible. Should these anatomical conditions be demonstrated, it will account for many things hitherto not satisfactorily explained. The rapidity with which substances taken into the stomach appear in the urine. It also accounts for the experiments of Gemelin, Tiedman and Magendie, in giving nitrate potassa, sometimes detecting it in the blood and sometimes not. It would also explain why poisons taken into the alimentary canal sometimes do not prove fatal. It has been proved by physiologists that the mesenteric veins take up the greater part of the digested alimentary substances, leaving to the lacteals the office principally of carrying off the oleaginous matters which have been digested by the action of the pancreatic juice. The prusiate of potash, when introduced into the stomach, has been detected in the urine in ten minutes

after taking it. Animals have been killed, during digestion, a few minutes after administering cyanide of potash, and the blood has been collected separately from the renal veins and arteries, expecting to find the cyanide of potash in the arteries; but it was found in the *veins*. These experiments have been repeated again and again, and always with like results, *during digestion;* but when the stomach and intestines were at *rest*, the contrary was the result. The prusiate of potash could be traced from the stomach in its course to the kidneys, finding it in the vena porta and in the vena cava, below the point where the hepatic veins emptied; but no where else in the general venous or arterial system;—thus showing that there was a different circulation during digestion from what existed at the time of abstinence. We will, then, consider the physiological fact settled, although opposed to our previous notions, in regard to the circulation of the blood. Yet the experiments of M. Bernard, so *often* and thoroughly made, and *always* with like results, can be accounted for in no other way.

Thus, then, we have during the period of digestion, a large quantity of fluid and digested matter absorbed by the mesenteric veins. While the stomach and intestines are full and at work, the circulation necessarily becomes more active; and owing to the double circulation through the liver, (the portal and the regular,) the blood passes but slowly. To prevent an undue distension of the blood vessels and consequent congestion of the liver, we find this wise provision; a system of vessels, conducting a portion of the blood from the vena porta to the vena cava, without passing through the capillary circulation of the liver. These blood vessels are found below the hepatic veins, at the point where the liver adheres to the vena cava ascendens.

M. Bernard has a specimen obtained from a horse injected with wax. They are as large as the veins of the stomach, and empty directly from the porta into the cava. Then again we

find the anatomical structure so necessary in order to carry on this circulation in the hepatic veins and in the cava. It has within a few years been ascertained that there exists *longitudinal* contractile muscular fibres in the hepatic veins, and in the vena cava, commencing exactly at the point where the hepatic veins empty into the vena cava, and terminating at the point of the cava where the renal veins empty into it, while in all the other parts of the venous system longitudinal fibres are no where to be found. The circular only exist. This arrangement, then, renders the vena cava capable of preventing too great a rush of blood to the right auricle, by contracting and forcing the fluid downward. The muscular fibres ceasing opposite the kidneys, the blood is sent through the renal veins to the kidneys during digestion, and thus the stasis is relieved. In the rabbit there are four valves below the orifice of the renal veins for the purpose of directing the blood through them.

In fishes and in reptiles, there exists a porto renal vein, through which a certain quantity of blood passes directly to the kidneys, from the mesenteric veins, and there subjected to its influence, before entering the general circulation, only a portion being sent to the lungs. Thus, then, if these statements of Bernard, Barreswell and Donaldson be true, and I see no reason to doubt them, we perceive the renal veins have a double duty to perform. For during abstinence, they conduct the return circulation from the kidneys, while during digestion, they act as arteries. These writers also affirm that pulsation exists in the renal veins during the act of digestion. Thus, then, admitting this smaller circulation, it readily accounts for what we never have been able previously to explain. We are all familiar with the fact of turpentine and asparagus, and various other articles, appearing in a few minutes in the urine, after being taken into the stomach, and before they could enter the general circulation so as to make their appearance in the urine.

During the contraction of the muscular coat of the inferior vena cava, its channel is diminished and the impeded blood flows off, right and left, through the renal veins to the kidneys, which eliminate from it such materials as are excessive and pernicious, and so the *urini cibi* is constituted. Meanwhile the order of the circulation is interrupted by the arrest of the blood ascending from the lower limbs, in consequence of the closure of the valves below the renal veins; but this disturbance is provided for by the existence of the vena azygos, which receives the impeded blood, and conveys it to the superior cava.

We come now to the most brilliant discovery in physiology for many years—the discovery of the *formation of sugar by the liver*. This discovery of Bernard, to use a current phrase in physiological science, must be admitted as a *finality* in medicine. It has been confirmed in the laboratory of Giessen, and by other chemists. He was led to institute inquiries from certain pathological phenomena which occurred in Diabetic patients, when fed exclusively on azotized food, i. e., they still continued to pass large quantities of sugar. He commenced a series of experiments, which were continued vigorously for two years, assisted by M. Barriswill. They were laboriously and perseveringly continued through this time. Of the extent of his researches, we can judge when we take into consideration that he has demonstrated that sugar is formed by the liver in the mammalia generally, both carniverous and gramniverous, in all birds, in fishes, both osseous and cartilaginous, and in the reptilia.

Bernard commenced his experiments in the following manner, with two dogs. The first was killed while active digestion was going on, after being fed on mutton and the bones of poultry. Sugar was found in the blood collected from the heart, while no traces of sugar could be detected in the stomach, intestines or in the urine.

The second dog was kept two days without a particle of food, then suddenly put to death. The blood again from the cavities of the heart afforded serum containing sugar, while no traces of sugar could be found in the stomach, intestinal canal or urine. These two experiments we clearly see settle the fact, that the sugar was found in the blood, independent of the nature of the food the animal was fed on, or the changes produced by digestion. We at once perceive that his next experiment would be to determine the source whence this sugar would be derived. We will now follow him, step by step, and see how he arrives at this brilliant discovery.

Again his experiments are performed on the canine race. A dog was killed seven hours after having heartily eaten of meat and bones. The abdomen was opened as speedily as possible. The digestive organs were found turgid with blood, and the lacteals filled with chyle. Blood was collected from the portal vein and from the cavities of the heart. Chyme was taken from the stomach and intestines, and chyle was collected from the thoracic duct. These were preserved separately, and carefully tested for sugar. There was none found in the chyme or chyle, but a large quantity was yielded by the portal blood, and a less quantity from the cardiac cavities.

In the second experiment, again the dog was kept for three days from all food, and the abdomen examined speedily after death. The digestive organs, instead of being turgid, were pale and anemic. The lacteals were full of chyle. The sugar was found, as before, in the cardiac cavities on the right side, and in the portal vein, although less abundant than in the previous experiment; while none was found in the chyle. These experiments were repeated with like results many times. One step is now satisfactorily taken, but whence the sugar? Here it is found, but whence its source?

From animals fed exclusively on an amylaceous diet, and

from those confined entirely to an animal diet, he obtained blood from the right auricles of each by means of a syringe introduced into the jugular vein, and tested the serum for sugar; in each he found sugar, whether they had been well fed or whether they had taken no food for days; whether subsisting on nitrogenized or non-nitrogenized substances. Yet whence the sugar?

He next examines the contents of all the venous trunks, the vena porta, (taking the precaution to tie it immediately after opening the abdominal parieties near the liver, so as to prevent the reflux of blood from it,) the inferior and superior cava, the jugular, &c., and no where could any sugar be detected but in the hepatic veins, in the ascending cava, and from thence to the right auricle. There was no trace of sugar in the blood flowing into the liver, nor in the pulmonary veins. The conclusion, of course, was, that it was *formed* in the liver, and *destroyed* in the lungs,—that there were two sources from which the system obtained sugar, one from the aliments, the other from the liver, as one of its proper normal secretions. He carried his investigations still further. He examined the principal organs of the body, by slicing them and washing them free from blood, and the liver was the only organ in the body which yielded any evidences of sugar, with the exception of the lungs, where he found a small quantity. In the liver it was abundant.

We can now imagine this eminent physiologist elated and full of enthusiasm. He goes directly to M. M. Pelouze and Dumas, *the* two chemists of Paris, and talks with them long and ardently; for he is elated with this brilliant discovery. They, naturally incredulous in regard to a point so likely to upset the established doctrines as to the formation of sugar, insisted that there *must* be some mistake; that it could not be so; and after witnessing his experiments, so tardy is the human mind to embrace any doctrine different from previous preconceived notions, they formed this plausible theory: that as the liver had the

property of retaining and accumulating within its tissues certain metallic poisons, it was probable these animals had a few days previously eaten amylaceous substances, and the sugar formed from them had not all passed off from the liver. To convince these eminent chemists, he kept his animals to be experimented on, for six weeks, from all substances from which it was possible sugar could be formed, and yet he found sugar in the blood coming from the liver, and in the parenchymatous tissue. And what is still more conclusive, it can *always* be detected in the liver of a fœtus after the fifth month. Further still, the fœtus of oviparous animals, which are separated from the mother, have exactly the same kind of sugar in their liver, and in no other organ. (*Am. Jour. Med. Sciences, July*, 1851.)

M. Vernoise, with the object of testing the validity of M. Bernard's researches as well as extending them, has recently submitted one hundred and seventy-three livers to examination, with the following results:

1st. That sugar constantly exists in the human liver, independently of alimentation. He found it in a case in which no food had been taken for fifteen days.

2d. Age appears to exert a certain amount of influence. The minimum amount was found from birth to two years of age; the maximum from twenty to fifty years of age. Sugar is found as early as the fourth month in the liver of the fœtus.

3d. Sex exerts no appreciable effect.

4th. The influence of disease upon the secretion is indubitable.

5th. The opaline aspect of a decoction of the liver is usually proportionate to the amount of sugar, as determined by the potash and Tromer's tests. And,

6th. That the anatomical conditions of the liver exert an influence, the quantity being lessened in proportion as the secretory structure is destroyed. (*Am. Jour. Med. Sci.* 1854, *page* 201.)

This last condition leads us back again to M. Bernard's experiments. He proved that the sugar found in the liver was a secretion, by showing the influence of the nervous system over its production; as an irritation of the opthalmic branch of the fifth pair leading to the lachrymal glands produces a copious flow of tears, so a slight irritation produced with a sharp pointed instrument applied to the medulla oblongata at the point of origin of the pneumogastric nerve produces an increase in the secretion of sugar, so much so that a large quantity is soon detected in the urine. In fine, Diabetes is produced artificially. Dr. Donaldson has witnessed the disease produced in this way at pleasure in dogs and rabbits. Too violent a shock to the nervous system will arrest it; and by the division of the pneumogastric nerve, the urine, which a few minutes before contained sugar, will cease to contain any; this division paralizing the liver.

Some still more recent observations tend to show that the grand sympathetic also serves as a conductor, as in a case of Diabetes observed by Dr. Duncan.

Diseases which exhaust the nervous energies of the body will often arrest the formation of sugar by the liver; for which reason it is seldom found after lingering diseases, and even in the last stages of Diabetes, it sometimes disappears during the exhaustion that precedes death. Andral relates a case where the patient was subject to attacks of diarrhae, during the existence of which, all traces of sugar in the urine disappeared.

McCullock relates a case of neuralgia, where each attack was followed by Diabetes. The puncture of the floor of the fourth ventricle of the rabbit in the middle of the calamus scriptorius, just between the filamentous radicles of the auditory and pneumogastric nerve, is followed in a few minutes by Diabetes. Puncture of the olivary bodies produces the same effect; and Bernard has carried his experiments to such an extent, he is able to estimate the amount of sugar that will ensue, according

to the amount of irritation inflicted on the nervous centres. This irritation had to be produced with a sharp pointed instrument, and with care, for if roughly made, and involving much lesion of the nervous substance, it fails to produce it, and may even arrest altogether the formation of sugar by the liver.

Several phenomena presented themselves during these experiments. Respiration was accelerated; the animals were in constant motion, as though they had taken strychnine. This continued as long as Diabetic urine was secreted, which lasted generally in the rabbit forty-eight hours, in the dog four days, and in one instance seven days.

Another curious fact was elicited in these experiments; the temperature of the body was diminished several degrees.

Some interesting letters from Dr. A. B. Hall, now in Paris, are in course of publication in the Boston Medical and Surgical Journal, on the effects of respiration on calorification, presenting the views of M. Bernard.

Although the formation of sugar by the liver is under the nervous influence, the *destruction* of it is not. M. Bernard, by a single experiment, showed that it was a chemical phenomena. He cut the pneumogastrics of an animal and injected some grape sugar into the blood, and found that it was consumed, as in the case of integrity of the nerves. Sugar in the blood also disappears when in contact with air out of the body as well as in the lungs. M. Bernard believes that the usual alkalinity of the blood favors the consumption of the sugar, but it is not the true cause. Bouchardat also agrees with Bernard that Mialhe erred in supposing that the alkalinity of the blood was alone sufficient to accomplish the destruction of the sugar; and that in Diabetes, the sugar is not destroyed because the blood is acid. But the alkaline reaction of the blood, though necessary to the decomposition of the sugar, is not of itself competent to accomplish that

change; and they affirm that the blood is not acid in Diabetes, nor after the suppression of the cutaneous transpiration.

The most active breathing animals form sugar in the greatest abundance. And there is evidence of a striking character to prove that the formation of sugar by the liver furnishes one of the conditions necessary to the proper performance of respiration. Dr. Vernoise, by producing artificial respiration in a decapitated animal, ascertained that the formation of sugar by the liver still goes on; and if the lungs are inflated with air mingled with some irritant vapor, such as chlorine, the sugar appears in the urine, and the animal becomes Diabetic after death.

It is somewhat significant that sugar should be mixed with the blood just before it is sent to the lungs for oxygenation; and that afterwards it disappears, and no traces of it can be found after leaving the lungs. It seems, therefore, reasonable to conclude that the sugar is destroyed at the lungs, in order to minister to the functions of respiration, and to the maintainance of animal heat. I shall look forward to Dr. Hall's letters, before alluded to, giving M. Bernard's experiments on the effects of respiration on calorification with much interest.

In an able and interesting letter from Prof. Samuel Jackson, of the University of Pennsylvania, written to my friend Dr. W. O. Brown, and published in the Boston Medical and Surgical Journal, I find the following views:

"In health, the portal blood entering the liver contains no saccharine substance; it is always found in the blood of the hepatic veins, as it issues from the liver, and in the blood taken from the right cavities of the heart. The blood taken from the left cavities of the heart and the vessels of the general circulation, yields no evidence of glucose or saccharine matter. Thus the sugar formed in the liver disappears in the lungs; it is decomposed in the pulmonary circulation. Glucose, or Diabetic sugar, is decomposed promptly in the presence of oxygen,

alkaline substances, nitrogenous bodies and water. These are present in the lungs, and in health the saccharine matter, a product of the action of the liver, is chemically destroyed by the respiratory process. It is most probably first converted into lactic acid, which, under the above stated conditions, is instantly broken up, its carbon becoming oxydized and converted into carbonic acid; its hydrogen, combining with oxygen, forms vapor of water, both of which products are eliminated in expiration, while the heat evolved serves to maintain the blood at its normal temperature, 98 to 100 deg. F. The functions of the liver and lungs are seen, in this respect, to be antagonistic. What the one produces, the other destroys. The glucose of the liver is thus prevented from entering into the circulation and being diffused throughout the economy.

"What, it may be asked, can be the intention of this singular provision? The following appears to me the most probable solution of the phenomenon. Heat and oxygen are the most indispensable conditions of life and health. Nature has taken corresponding precautions to renew a constant supply of an agent of so much importance as heat. From six to seven parts of eight, of our aliment are destroyed for the production of heat. They are the hydro-carbons or calorifacient elements of food. They are incapable of serving for nutrition or the production of organized structure. They are intended to undergo oxydation or combustion, for the purpose of keeping up the temperature of the body. Fat is not an organized tissue; it is not properly an organic portion of the economy. It is the surplus hydro-carbon of the food, stored up as fuel to be employed for the production of heat when the exterior supplies are cut off. Now it is a common, almost constant, occurrence, that either from disorders of the digestive organs, or other causes, the blood receives no supplies of hydro-carbons from the food, and that the store of fat is being rapidly consumed and exhausted.

In this emergency, the economy has provided a resource within itself, by which it obtains these important elements, and can maintain the indispensable conditions for its existence; a temperature of 98 deg. F. This resource is the function of the liver, by which it manufactures glucose, a substance rich in carbon and hydrogen, as is shown by its formulary—C. 12, H. 12, O. 12. Almost the same instant that glucose leaves the liver, from the rapidity of the circulation, it is thrown into the lungs, and is there burnt up, producing carbonic acid and water, both eliminated with evolution of caloric, which is absorbed by the blood and diffused throughout the organism. Corroborative of the above facts and views, it has been ascertained by Reynose and others, that in various affections which injure, more or less, the lungs and their functions, as emphysema, phthisis, bronchitis, pneumonia, there is a corresponding proportion of glucose found to exist in the urine.

"From the preceding facts, the pathology of Diabetes Mellitus would appear to rest on the solution of this problem. What are the circumstances that impede the healthy action of the lungs from decomposing the glucose manufactured in the liver, and introduced into the lungs from that organ? Mialhe asserts it is the deficiency or absence of the alkalinity of the blood.* On this hypothesis is founded the treatment of the disease by alkalies."

Reynose, Dechambre and others, contend that the disease depends upon some defect in the respiratory process.† M. Bernard's views you already have, that it is attributable to a direct nervous action on the liver.‡

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*Braithwaite, No. 19, p. 110. †Braithwaite, No. 26, p. 112.

‡Since this dissertation was read, I find in the July number of the American Journal of Medical Sciences for 1854, the following: The theory which refers the original lesion to the nervous system, and considers the defective assimilation as a mere symptom, appears to gain ground among London physicians. Dr. Goolden of St. Thomas Hospital, relates the case of a man who received a severe blow on the head; and while suffering from the consequent cerebral symptoms, passed large quantities of sugar in his urine. Guided by this fact, as well as by the well known experiments of Bernard, the treatment was directed to the head. Four cases have

Dr. Donaldson, in the able article previously alluded to in the American Journal of Medical Sciences for July, 1851, says this discovery of the hepatic secretion by Bernard shows us the nature of Diabetes Mellitus; for that disease has, as its principal symptom, an excess of this identical sugar.

At first, Bernard was inclined to believe that the cause of the production of an abnormal quantity was some affection of the eighth pair of nerves. But his more recent researches have modified this opinion. Whether the primary lesion (*if* any) exists at their point of origin, or in the lungs or liver itself, it is at present somewhat difficult to decide.

Drs. Duncan, Rutherford, Sir B. Brodie and others, found the kidneys increased in volume. M. Dezimeris notices the increase of bulk of the kidneys in three cases which occurred at the Hotel Dieu in one year. In all the cases the volume of the kidneys was much enlarged. Andral, in his autopsies, found hypertrophy of the kidneys. This is easily accounted for from the *increase of function*, as in obstructed heart; and when we remember that the secretion from the kidneys is greater than any other secretion, that even the healthy kidney requires a great amount of vital energy for the proper performance of its function to remove all the urea, a part of the water, and leave all the albumen, (for in a state of health, albumen is found in all the fluids and solids in the body *except* the urine,*) we can easily account for the hypertrophy.

Dr. Jones says: "When we look at the morbid anatomy; when minute microscopical examination can give no clue to the seat of the disease; when it pronounces that the stomach and viscera are healthy; when it indicates that a functional error has ended life; we are led to hope that further investigation

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been, or are, under treatment in St. Thomas, and in two, very great benefit appears to have been derived; the patients in the meanwhile were not restricted in any way as to the use of vegetable food.

*Medical Gazette, May, 1840.

[some remarkable experiments by Dr. Harley on the artificial production of Diabetes in animals by the action of stimulants injected into the vena porta,] may lead to the perfect theory of this disease, and by this to the radical cure, instead of the palliative treatment of this most interesting disease." (*American Journal Sciences*, *April*, 1854.)

I should not forget to mention, that very recently Dr. Hassall has published a very valuable paper in the Medico-Chirurgical Transactions on the developement of Torulæ in the urine of Diabetic patients. When sugar cannot be detected by Tromer's test, he has been able to detect, by the microscope, the "sugar fungus," and in some cases a higher stage of development.

Treatment.—This, after all, ought to be the end and aim of all scientific medical researches. Various specifics have from time to time been recommended, but thus far all trials have failed.

1st. The Permanganate of Potash has lately been proposed by Mr. Sampson. He relates a case in which it appeared beneficial. Dr. W. R. Basham tried it in two cases. During the administration, the amount of urine diminished, but the sugar increased. Dr. Wood of Philadelphia has tried yeast with some advantage. Dr. Gray of Glasgow has tried rennet. These remedies have been tried on the principle that, as they convert sugar out of the body into acid products, they might bring about analogous changes in the stomach.

2d. Those agents that would retard the formation of glucose. Certain substances possess the property of arresting the saccharine, vinous and acetous fermentations. These are glycerine, creosote and sulphite of soda. These agents thus far appear of doubtful efficacy.

3d. Opiates. These agents are certainly palliatives, and by diminishing the excitement and irritability of the nervous centres,

are *very beneficial.* They usually relieve thirst, diminish the amount of urine, and relieve the obstructed perspiration of the skin.

4th. The acids, more particulatly the hydro-chloric acid, which also relieves the thirst, and appears to aid the digestive process and diminish the quantity of urine. This remedy has been recommended by Dr. Owen Reese. A case is related in the Medical Observatory, Feb., 1842, cured with hydro-chloric acid.

5th. Diaphoretics. These, in conjunction with opium, are always beneficial. Warm baths, flannel clothing. This latter remedy should always be strictly enjoined; it always appears to be of use.

6th. Ammonia and Alkalies. The testimony of all more recent writers on this disease is in favor of this class of remedies, particularly the carb. ammo. Of the *modus operandi* of this class of remedies, little is known beyond what is hypothetical. Mialhe states that the blood is destitute of the alkaline salts; and he affirms that the ultimate conversion of the sugar formed out of the food into products capable of being eliminated by the respiratory function, is not effected in consequence of the deficiency. To supply this defect, should be the leading principle in the treatment of this disease.

Whether we adopt this theory or not, it has been more beneficial than any other. A well regulated diet, limited as much as possible to animal or nitrogenous food, in combination with the steady and persevering use of the carb. ammo.,* together with flannel clothing, has effected more than any other plan of treatment. Bouchardat ranks clothing next to diet. The intelligent co-operation of the patient is necessary, in order that he may refrain from bread and vegetables. It is necessary

*The writer thinks the carb. ammo. produces a better effect in this disease when administered in cinnamon water.

that the patient should deny himself from all articles of food known to be injurious.

Spirits, as brandy, whiskey and rum, usually contain no traces of sugar, and can be prescribed. Claret contains none. Porter contains twenty-three grs. to forty, of saccharine matter to the ounce. Hence porter is not admissible.

M. Bouchardat, who has seen more of this disease than any one, says milk is injurious.

Dr. H. Bence Jones, on account of the termination so frequently by phthisis, and on account of the emaciation, has used cod liver oil, and, as he affirms, with great advantage ; all gained in flesh, and the urine diminished in quantity, yet the sugar did not disappear.

A case of Diabetes is reported in the Boston Medical and Surgical Journal, March 8, 1854, by A. B. Crosby of Hanover. The treatment was a cathartic of castor oil, to be followed by cod liver oil, three grains of phosphate of iron, and six drops of liquor potassa, each three times per day, at intervals of one hour. The patient confined entirely to an animal diet. This case was of short standing, but the cure appears to be perfect, at the time the case was reported. It was attended by Dr. Mitchel Davis of Thetford, Vt. The treatment was advised by Dr. Dixi Crosby of Hanover. The patient was six years and eight months of age.

It has often been observed that in fat persons the disease progresses much slower than in those of the opposite condition.

Quinine, in combination with iron, has been beneficial. Ox gall, strychnia, arsenic, colchicum, and iod. potass. have been recommended. And *very recently* a new remedy has been proposed, and it would seem with some degree of plausibility ;—the protoxide of nitrogen, or nitrous oxide, discovered by Dr. Priestly. When we consider that this saccharine material is a true physiological product, and only connected with a morbid condition, when

produced in excessive quantity, or not normally disintergrated, and when the most careful examinations can find no pathological condition to account for the disease, we may hope that recovery will soon be as certain, as the fatality that now attends it. Then we can truly say we hold the "golden compasses" of the poet, with which we mark off the boundaries of this disease, and fill up its circumference with the appropriate remedies.

In the selection of our remedies for the cure of diseases, we do not point our patients to the crystal fountain, and tell them there is all that is necessary to cure the various "ills that flesh is heir to." We do not say the vegetable kingdom alone furnishes us with all the remedies necessary to cure disease; neither do we say to them, one system alone guides us in the selection of our remedies. We do not say one theory, and the same treatment, are adapted to every species of derangement in the functions of the various organs. We are governed and sustained by a *higher* degree of *erudition* and *moral principle*.

We select our remedies from the modest flower that rises by the way side, and exhales its sweetness on the ambient air to the sun, out of which orb come the never ceasing rays of light that break on the outermost limits of the universe. Not a tree, or a leaf, or a stone, or a river, out of which virtue of some kind is not found. Not a substance which has not its attractive or repellent forces, and which does not impart either health or poison. Could we see into the life of all things, and know all the properties they possess, how they act and react on each other, the grandest conception of the imagination could hardly outrun the sober truth of philosophy.